MICROCOPY RESOLUTION TEST CHART

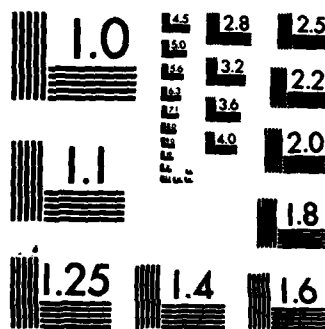NATIONAL BUREAU OF STANDARDS-1963-A

UNITED STATES ARMY RECRUITING COMMAND

Study Report 81-2 AD

A Study of the Effectiveness of the Army's National Advertising Expenditures

Volume II
Main Report

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N W AYER INCORPORATED
AUGUST 1981

Prepared for the
United States Army Recruiting Command
Fort Sheridan, Illinois 60037

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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD39994 3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) A STUDY OF THE EFFECTIVENESS OF THE ARMY'S NATIONAL ADVERTISING EXPENDITURES VOLUME II	5. TYPE OF REPORT & PERIOD COVERED Final Draft 27 Sept 79 – 31 Aug 81 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) N W AYER INCORPORATED	8. CONTRACT OR GRANT NUMBER(s) MDA903-79-D-0001
9. PERFORMING ORGANIZATION NAME AND ADDRESS N W Ayer Inc. 1345 Avenue of the Americas New York, NY 10105	10. PROGRAM ELEMENT PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS United States Army Recruiting Command Ft. Sheridan, IL	12. REPORT DATE 31 Aug 81 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) N/A	15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION DOWNGRADING SCHEDULE N/A

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

N/A

18. SUPPLEMENTARY NOTES

Volume II of three volumes.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

ADVERTISING, ACCESSIONS, CONTRACTS, ACCESSIONS AS CONTRACTED, ARMY, RECRUITING, EFFECTIVENESS, COST, MODEL, BOX-JENKINS, ECONOMETRIC, ASVAB, EXAMS, CONVERSION, LINKAGE.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

ARMY ADVERTISING COST EFFECTIVENESS MODEL.

the army's advertising expenditures were shown to be cost-effective. In a sequential and linear process. Advertising was related to ASVAB exams, and exams were then related to accessions.

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The U.S. Army Recruiting Command (USAREC) has asked N W Ayer Incorporated to study the effectiveness of the Army's national recruitment advertising. N W Ayer's Marketing Services Department undertook this task in September, 1979, with guidance from USAREC's Program Analysis and Evaluation Division. In addition, their assistance in acquiring, providing, and checking data and data sources was essential.

Volume I is the Executive Summary and is intended for the general reader who wants an overview of the project's objectives, methods, and key findings. This summary highlights the marketing and financial aspects of the analysis.

Volume II is the Main Report and is intended for the reader who wants to fully understand the details of the project: its inception, methodology, data, results, validation, and economic implications.

Volume III is comprised of Appendices intended for the specialist who wants to thoroughly analyze the methods and data used in the analysis. A step by step description of how the model was built is documented in the Appendix entitled "Essential Elements of Analysis."

At our request our methodology and conclusions have been reviewed by Professor Martin K. Starr of the Graduate School of Business of Columbia University. He judged our statistical procedures sound and the conclusions acceptable on a statistical and analytic basis.

The findings in this report are not to be construed as an official Department of the Army position, unless so designated by other authorized documents.

A STUDY OF THE EFFECTIVENESS OF
THE ARMY'S NATIONAL ADVERTISING EXPENDITURES
VOL. II
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A STUDY OF THE EFFECTIVENESS OF
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CHAPTER 1

INTRODUCTION

Section I. PROBLEM

Is U.S. Army advertising paying off? Does it help recruiting or not?
Should Army advertising levels be increased or decreased relative to
Army pay or the level of the Army's recruiting force?

These are questions of accountability. How can N W Ayer more fully
justify its expenditures to its client? How can the Army in turn better
explain this portion of its budget to the Pentagon and to Congress?

These appropriations have been challenged in the past. In 1976 the
General Accounting Office (GAO) investigated the effectiveness of mili-
tary advertising and found that the accession of "...few recruits can
be traced to advertising and that the attitudes toward and images of
the military have not changed greatly for better or for worse." Cuts
in advertising budgets followed the publication of the GAO report.
Recruiting then plummeted. Why? Because advertising was cut back?
We think part of the drop in recruiting was due to the drop in advertis-
ing. The full story is complex, and we were led to consider many other
factors. This study is directly aimed at resolving the issue.

Section II. HISTORY OF THE APPROACH

N W Ayer's interest in demonstrating the effectiveness of its Army
advertising goes back a long time. In 1971, four years after N W Ayer
acquired the account, the Marketing Services Department of N W Ayer
developed a proposal for measuring advertising effectiveness for the
Army.

This early proposal was not accepted for two reasons. First, the Army
did not have a large recruiting task in 1971: the draft was still in
effect, so there was little need for the research. Second, since re-
cruiting information was not kept as systematically as it is now, the
Army did not have the data to easily support the research.

In 1978 N W Ayer reapproached the Army. Conditions had changed. The
all-volunteer Army had replaced the draft Army. Enlistment bonuses
supplanted draft boards. Recruiting quotas had to be met. By 1978 it
was clear that the success of the first years of the all-volunteer
Army was not being sustained, and there was increased pressure to improve
the effectiveness of the Army's recruiting tools.

Also by 1978, recruiting data was being kept more systematically. Data on
accessions (enlistments) had been collected since 1971. This historical
record invited us to re-pursue the question of advertising's effective-
ness. Since 1978 we have become very familiar with the recruiting data
stored at the Defense Manpower Data Center (DMDC).

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[1] "Advertising for Military Recruiting: How Effective Is It?" Report
to the Congress by the Comptroller General, FPCD-76-168, March, 1976.

In this analysis, we discuss the effects of advertising on exam-taking by Army prospects. DMDC began collecting exam-taking data in a uniform manner during 1976, and this project started to flourish once we discovered the data on exams. The importance of this data is discussed later in this chapter.

We will try to put this project into perspective in two ways: first, we will identify a range of general methods for establishing the effectiveness of advertising and then identify which one we chose; second, we will describe how our study differs from others that have been used to establish the effectiveness of advertising as a recruiting tool for the military.

Section III. GENERAL METHODS

Selection of a Criterion.

The first issue to consider when trying to measure advertising's effectiveness is to decide on a criterion. Several criteria make sense when we consider Army advertising. Examples follow:

Awareness – do young men and women know that the Army is actively seeking enlistments and offering jobs?

Interest – how interested are the target groups in the specifics of the Army job?

Attitude – how does the Army job rate relative to other post-high school options?

Behavior – what does the prospect do?

We did not choose to measure awareness because we felt that general awareness was already so high that it would be a meaningless criterion.

We also did not choose interest or attitude as a criterion because existing surveys on interest and attitudes are not very numerous: Market Facts tracks the attitudes of youth only twice a year, and we do not believe these surveys are frequent enough to pick up the effects of advertising.

We had hoped to find a behavioral criterion sensitive to advertising, since changing behavior is the ultimate measure of advertising effectiveness. Several behavioral criteria were considered:

. REACT Leads.
N W Ayer already has an elaborate system for tracking responses to direct response advertising. We wanted a criterion that would measure the effectiveness of all media.

- Station Visits.
  An old adage of advertising is that the ads bring the prospect
  in the door. From then on the salesman and the product itself
  takes over. Counting the number of visits to a recruiting
  station would be an ideal criterion, except that many prospects
  do not visit their local recruiting station. For example, some
  recruiters go to prospects' homes.

- Exams.
  The Army asks all prospects to take mental and physical exams,
  which are used to match prospects to jobs for which they qualify.
  Since these exams are very time-consuming, exam-taking demon-
  strates a significant interest in the Army. As such, it is
  close to an ideal criterion.

- Contracts.
  Everyone who joins the Army must sign a contract. The major
  problem with choosing this behavior as a criterion for adver-
  tising is that a host of other factors intervene at this point
  in the process: the job the prospect wants may be filled for 6
  months; the prospect may not qualify for a job he likes; he may
  not want to go to Army school in the South in the summer or in
  the North during the winter.

- Accessions.
  When a prospect accesses is largely determined by the school
  year and by when the Army has job openings. As a result, this
  criteria is heavily influenced by seasonality as well as by the
  other factors that impact contracts.

To summarize, we wanted a behavioral criterion and chose exam-taking
as best criterion available.[1]

Experimentation or Econometrics.

We next addressed the question of how to measure the effect of adver-
tising on exams. There are two basic choices: experimentation or
statistical analysis of historical data.

Experimentation is clearly preferable whenever one can dramatically
vary advertising in sensitive markets under controlled conditions;
however, it has not been tried. It was considered in 1971 but
rejected on grounds that the Vietnam War precluded tampering with
recruiting activities in any part of the country.

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[1] As discussed in Chapter 2, we will link exam-taking to accessing
in to better measure the ultimate effect of advertising.

The current project tried the second course, econometrics, to try
to deduce the effectiveness of advertising by observing how historical
changes in advertising affected changes in recruiting. Our methodology
is described in Chapter 2.

Section IV. OTHER STUDIES OF MILITARY RECRUITMENT ADVERTISING

How does our methodology fit with other studies addressing military
advertising? We will first compare our study to the GAO study referred
to earlier. Second, we will compare our study to an econometric study
of the effectiveness of Navy advertising that was recently published
by Professors Morey and McCann of Duke University.[1]

The GAO Study.

The conclusions of the GAO study rest upon two separate analyses.

1. THE ATTITUDES AND IMAGE ANALYSIS

   The GAO found that numerous studies showed little variation
   in attitudes toward and images of the military services
   between 1970 and 1974, even though advertising expenditures
   had increased substantially during that time.

   Our study, in contrast, measures behavioral rather than atti-
   tudinal response. Advertising does not have to produce a
   large shift in the attitudes of all young men and women to be
   cost-effective. If it influences only a small percentage of
   the population, but does so with enough strength to get them
   to see a recruiter, take an exam and eventually enlist, it
   has done a cost-effective job. Small percentage changes in
   attitudes are difficult to measure. Finally, attitudes measured
   in 1970-1974 were no doubt heavily influenced by the Vietnam
   War.

2. THE LEADS ANALYSIS

   The GAO found few enlistments traceable to advertising leads:
   only 4% of 900,000 leads traced to an enlistment and only 2%
   enlisted in the service to which they sent their lead. The
   GAO went on to show that less than 10% of 550,000 enlistees
   sent in a lead. We hypothesize that the counting system
   itself was inefficient and inaccurate, since the counting of
   leads failed to reflect the effect of media that don't provide
   lead cards. In contrast, the data input into our study is
   far more accurate, since all potential recruits taking exams
   have been carefully counted since 1976.

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[1] Richard C. Morey and John M. McCann, "Evaluating and Improving Resource
Allocation for Navy Recruiting" in Management Science, Vol. 26, No. 12,
December, 1980

The Morey and McCann Study.

The Morey and McCann article is an econometric study similar in philosophy to this study. Both studies analyze historical recruiting success in the context of key controllable and noncontrollable factors in the environment. The differences between the two modeling procedures are listed below:

1. The Morey and McCann analysis measures effectiveness of advertising in terms of enlistment rather than exams. They do refer to the potential benefits of multi-stage modeling, however, and we speculate that they would have modeled exams had they had the data available.

2. Morey and McCann analyzed high school degree enlistees as a single group. Our analysis considers potential recruits by mental groupings as well as by high school status.

3. Morey and McCann use a Koych autoregression term to represent the dynamic effects of advertising. We use Box Jenkins transfer function procedures to select the dynamic effect. The latter procedures are more flexible and they could have led to the Koych specification, but did not.

4. Morey and McCann use leads as an independent variable in addition to an advertising expenditure variable. We do not employ leads as either an independent or a dependent variable.

5. Morey and McCann model across 43 recruiting districts and across 24 months. In contrast we model aggregates across 54 months. This geographical detail provides Morey and McCann with much more data than we have available to us.

Section V. ASSUMPTIONS

The purpose of this section is to list the key assumptions that underpin the modeling effort.

1. Historical analysis brings useful information to bear on current policy issues. Our analysis covers the period from April 1976 to September 1980. We assume that the relationships between recruiting and advertising have not changed substantially since that time.

2. We have discussed our modeling effort with numerous researchers and administrators in and out of the Army, and we believe that we have considered modeling all of the important factors.

3. Lastly, we assume that levels of monthly advertising are not systematically determined by levels of recruiting success in prior months. Such relationships, commonly referred to as "feedback loops", require that two relationships be

modeled simultaneously — one explaining the determinates of advertising and the second explaining the current and delayed effects of advertising. Such a feedback relationship is not uncommon, since many commercial and industrial markets routinely set advertising budgets as a percentage of their prior year's revenues.

Army budgets, in contrast, are not set in routine manner. A host of military and political factors interact, with the final decision being a Congressional one. In addition, the eventual monthly allocation of the budget is structured well in advance and is difficult to change. As a result of both of these factors, we have adopted statistical methods which preclude feedback.

Section VI. SCOPE AND LIMITATIONS

Our study analyzes the effect of advertising on exam-taking and on eventual accessions nationwide from the period July 1976 to September 1980: 54 data points. The study would have been improved if regional detail had been available so that data pooling techniques could be employed.

Chapter 2 will describe our methodology and Chapter 3 our data. Chapter 4 will present the results, Chapter 5 will discuss the validity of our models, and finally Chapter 6 will analyze the economic implications of the models.

CHAPTER 2

METHODOLOGY

The methodology used to develop the models needed to effectively measure the impact of advertising spending levels can be outlined in eight steps:

1. Identification of the basic procedural structure;

2. Identification of assumptions and hypotheses regarding the number of, the form of, and the variables in each model;

3. Inspection of the data on exam-taking;

4. Estimation of the immediate and delayed effects of variables other than advertising on exam-taking;

5. Estimation of the current and lagged effects of advertising on exam-taking;

6. Joint estimation of advertising and non-advertising effects on exam-taking;

7. Linkage of exam-taking and accessions, and

8. Implementation of diagnostic checks to insure model robustness.

Each of the first seven steps is elaborated upon in the following pages of this chapter. The eighth step is discussed in Chapter 5, "Validation".

Section I. IDENTIFICATION OF THE BASIC PROCEDURAL STRUCTURE

As outlined below, careful consideration of the procedural structure led us to the construction of a two-stage model of the recruiting process.

The Process Flow.

The first step in structure identification is the development of a process flow. The objective of developing this process perspective is not to incorporate into it every element of the recruiting system, but to outline those elements which are critical to developing a measurement of the influence of advertising spending levels. With this measurement based on a sound perspective of the process dynamics, the risk of confounding the impact of advertising spending with the changes in other system factors is considerably lessened.

The process flow must identify the key variables in the system, as well as the causal patterns connecting them. The Process Overview seen in Figure 2-1 provides this broad perspective of the system's dynamics.

This overview of the recruiting process specifies that the pool of eligible enlistment candidates receives a continuous flow of information that affects attitudes toward enlisting in the Army. This flow comes from both the Recruiting Command in the form of advertising, which provides information about the Army as a product offer (pay, benefits, and training opportunities), and from the general economic environment, with information about alternative employment, education, and other military service opportunities.

The information varies in the intensity with which it is delivered (e.g. advertising pressure), and also reflects changing environmental states (e.g. increased unemployment). The quantity and quality of this information acts to impact both the level of awareness of Army opportunities and attitudes towards the Army.

These changes in awareness and perceptions create an atmosphere that affects responsiveness to contacts made by the recruiter force, and induces people to seek out recruiters on their own. The quality of the recruiters' "selling" of the Army, impacted somewhat by alternative service recruiting efforts, results in a number of candidates making a commitment to begin the enlistment process by going to the AFEES stations and taking the mental and physical exams.

Once the examination process has been completed, the percentage of signed contracts is heavily dependent on the manpower requirements of the Army, as well as on the effectiveness of the career counselling staff. Finally, the willingness of examinees to sign contracts is determined by a number of factors such as the availability of specific MOS slots, the timing and location of schools, the flexibility of the DEP policy, and the seasonality of the school year. These factors also affect the timing of accession by those who sign contracts.

Choice of a Two-Stage Model Building Procedure:

The second step in structure identification is the choice of a overall model building procedure. Careful consideration of the process flow makes it clear that the system payoff, the number of accessions each month, is considerably "downstream" from the level of advertising spending, which is the critical variable being investigated.

As discussed in Chapter 1, monthly data reflecting changes in awareness levels and attitudes of the target group toward the Army was not available, nor was monthly data available on the number of contacts made with the recruiting system. The number of ASVAB exams completed each month was available, however, and represents the system performance measure furthest "upstream" in the process.
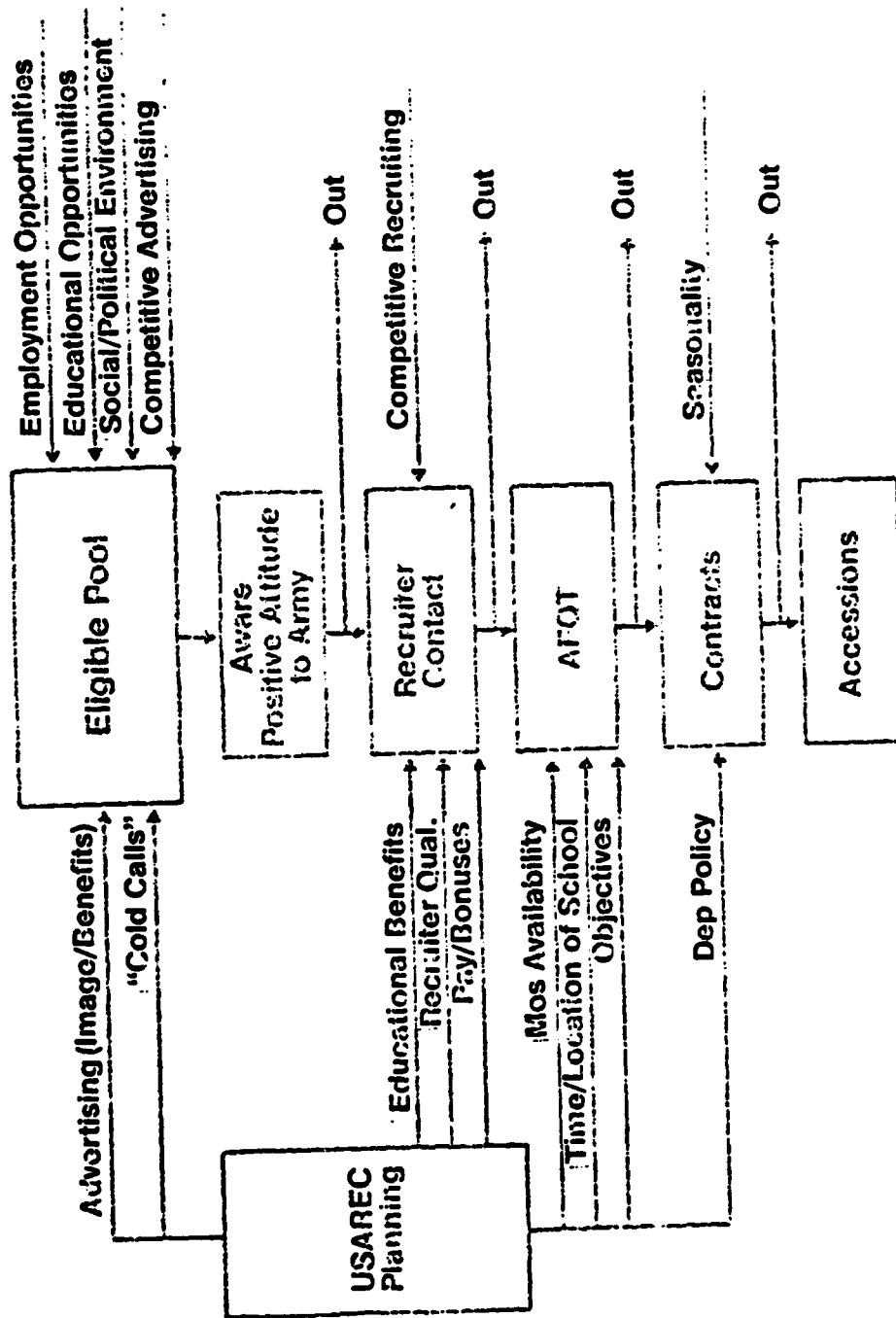
Figure 2-1. Process Overview

In order to measure the system's response at the point most sensitive to changes in the level of advertising (exam counts), as well as to track variations in the key payoff measure (accession levels), we used a two-stage model of the process. Accession records were reviewed, and each accession was allocated to the month in which the enlistment contract was signed. This is effectively a contract series, exclusive of those contracts that do not result in final accession. To our knowledge, this is the first time that recruiting performance has been measured using a criterion so far "upstream" in the enlistment process. Stage 1 relates exam levels to changes in advertising, other policy variables, and critical non-controllable environmental influences, and Stage 2 relates accession levels to changes in exam levels.

Figures 2-2 below simplifies the process perspective in terms of the two stages:
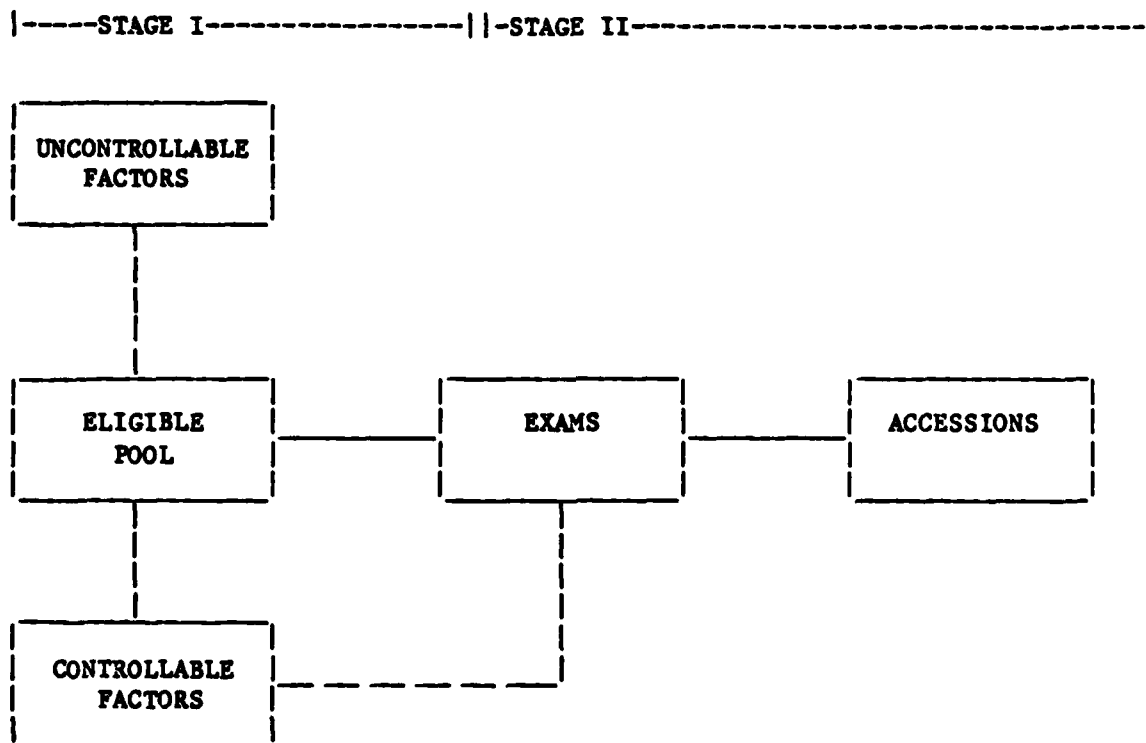
Figure 2-2. The Two-Stage Process

Section II.   IDENTIFICATION OF ASSUMPTIONS AND HYPOTHESES

The implementation of the two-stage process required specifying
two types of models: exam models (monthly exam levels explained by
advertising, other policy variables and environmental factors), and
accession models (linking accessions to exam levels).

The Number of Exam Models.

Army priorities for the quality of the recruit mix required investigating
the differential impact of advertising on key market segments. Market
segmentation was based on high school degree status and test scores by
mental category groups:

> High School Degree - Category I - IIIA
> High School Degree - Category IIIB-IV
> Non-Degree   - Category I-IIIA
> Non-Degree   - Category IIIB-IV

The appropriate degree status could not be specified in the exam data,
since the records reflect the status at the time of examination, not
at the time of accession, and therefore underrepresent the number of
graduates. With this restriction in mind, the exam data was parti-
tioned by mental test scores into two groups, Category I-IIIA and
Category IIIB-IV, and an exam model was built for each.

The Form of and Variables in the Exam Models.

Based on the theoretical perspective outlined earlier and on the avail-
ability of appropriate monthly data, each exam model specified that
monthly variation in ASVAB exam levels is determined by variation in
the factors listed below.

Uncontrollable environmental factors include

> - youth unemployment (16-19)
> - civilian minimum wage rate
> - structural seasonality
> - alternative service advertising levels.

U.S. Army Advertising spending levels considers individual media expenditures.

Other controllable policy factors include

> - monthly recruiting objectives
> - number of recruiters on production
> - E-1 pay levels.

The Number of Accession Models.

The accession data was partitioned into the four specified market segments, and accessions were modeled separately for each of the first three groups—

> High School Degree — Category I-IIIA
> High School Degree — Category IIIB-IV
> Non — Degree   — Category I-IIIA

The last group was considered to be more constrained by the demands of the Army than by the supply of candidates, and was not subjected to the same analysis detail, because it was felt that accession variation reflected administrative pressures, as much as the response to marketing efforts.

The Form of and Variables in the Accession Models.

The key issue in determining the form of the accession models was whether the model should be linear or non-linear. If accessions increase at a diminishing rate as exam-taking increases, then the accession model must be a linear function of exams. We investigated this issue by plotting the level of exam-taking on a given month against the ratio of exams to accessions in that month. This ratio is an estimate of the conversion rate from exams to accessions.

All of the variables hypothesized for the exam model were considered for inclusion in the accession model, because we felt that it was important to investigate the possibility that variation in one or more of the key system variables would impact the mix of people who came in to take exams, with respect to their propensity to eventually enlist.

Section III. INSPECTION OF THE DATA ON EXAM-TAKING

We analyzed plots of the exam-taking data before modeling the effects of the hypothesized variables, in order to determine if there were any dramatic patterns in the data that would need explanation before proceeding. We also performed a Box Jenkins univariate analysis of the exam data to see if additional seasonal or first-order auto-regressive factors would be needed in the exam model.*

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*The Box Jenkins univariate analysis is discussed in detail by George E.P. Box and Gwilym M. Jenkins in Time Series Analyses, published by Holden Day (San Francisco, 1976).

Section IV.   ESTIMATION OF THE IMMEDIATE AND
              DELAYED EFFECTS OF VARIABLES OTHER
              THAN ADVERTISING ON EXAM-TAKING

To properly address advertising, we split monthly exam variations into
two parts: the first part explained exam variation by the key non-
advertising factors, and the remaining part, or residual variation, ex-
plained any remaining variation by changes in advertising spending pat-
terns. This was done in order to neither overstate the efects of adver-
tising nor miss an advertising effect buried under the effects of a more
dominant variable. Removing the effects of non-advertising variables was
particularly important since our eventual goal was to measure the impact
of potentially subtle individual media effects.

Box Jenkins cross-correlation analysis* was then used to determine if the
impact of any of the hypothetical factors on exam levels had a long enough
delay to warrant including lagged values of that factor as an independent
variable. The cross-correlations were computed between the current value
of the exam series and the current value (as well as up to twelve lagged
periods for each) of the independent variables. The Box-Jenkins technique
of "pre-whitening" each of the series before computing the cross-correlation
was used.** This technique is designed to reduce the chance of making
spurious cross-correlation estimates due to the presence of an auto-cor-
relation structure in the variables.

Once the relevant delay structure for each of the non-advertising factors
was established, the coefficients of an equation that specified exams as a
linear function of the current and appropriate lagged values of the non-
advertising factors were estimated, using multiple regression. With the
"non-advertising" model thus specified, and parameters estimated, the
residual effects could be computed.

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*The Box Jenkins univariate analysis is discussed in detail by
 George E.P. Box and Gwilym M. Jenkins in Time Series Analysis,
 published by Holden Day (San Francisco, 1976).

**"Pre-whitening" each variable before computing cross-
  correlations is equivalent to concentrating on the effects
  of a variable when it assumes unusually high and low
  levels.

Section V. ESTIMATION OF THE CURRENT AND DELAYED EFFECTS OF ADVERTISING

The objective here is to identify correlations in the response patterns of exam levels to changes in each of the media, so that the eight media components could be combined into a smaller number of media aggregates. This reduced the variety of the advertising response, while maintaining any essential differences in the nature of the delay structure.

The cross-correlations between the residuals of the pre-advertising exam model and the advertising spending levels for each of eight major media components were developed.[a] Again, the Box Jenkins "prewhitening" technique was used before computing the cross-correlations.[**] The structure of the relationship between residual exam variations and the media components was examined to determine the strength of relationship and the structure of the delays.

Section VI. JOINT ESTIMATION OF THE EFFECTS OF THE ADVERTISING AND NON-ADVERTISING VARIABLES

The combined effects of non-advertising and advertising variables were jointly estimated, using distributed lag analyses to refine the estimates of advertising's delayed effects. Then all of the foregoing information was taken into account in estimating final models. The parameters of a model, including all variables, delay structures, and key media aggregates were specified using regression analysis.

Section VII. LINKING EXAMS TO ACCESSIONS

The last stage before validation in the model-building process is to determine which factors link exams to accessions. Multiple regression was used to determine whether any of the hypothesized factors affected the linkage.

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[*]Time Series Analysis, by Box and Jenkins, also describes cross-correlational analysis.

[**]"Prewhitening" each variable before computing cross-correlations is equivalent to concentrating on the effects of a variable when it assumes unusually high and *
levels.

CHAPTER 3

DATA

The data used in the analysis can be classified into four sets:*

- Measures of recruiting performance
- Measures of advertising expenditure activity
- USAREC-controllable policy variables
- Non-controllable environmental influences

The data span the time period from July 1976 to September 1980.

Section I. MEASURES OF RECRUITING PERFORMANCE

Recruiting performance was measured by two variables: the number of ASVAB exams completed each month in the AFEES stations, and the number of contracts signed each month that actually turned into accessions. The source of this data is the Defense Manpower Data Center (DMDC).

Section II. MEASURES OF ADVERTISING EXPENDITURE ACTIVITY

The advertising data used in the analysis reflects historical monthly expenditures as reported by the N W Ayer Media Department. These expenditures were made to purchase advertising space directed toward the non-prior service market segment.

Three key considerations were made in specifying the advertising variables:

- Individual media components were analyzed to account for differing responses.

- The reported dollar expenditures for each medium were adjusted by the appropriate media deflator so that all expenditure levels throughout the analysis are reported in constant dollars (December 1978 = $1.00). The deflators were developed using data from Marketing and Media Decisions.

- Reported gross expenditures (including agency commissions) were adjusted to reflect net expenditures (exclusive of agency commissions) where necessary.

The eight media types considered are television, radio, newspaper, outdoor, regular magazines, special magazines, local advertising, and direct mail.

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* Listings and plots of the variables in each data set are included in the data appendix.

Section III.   USAREC-CONTROLLABLE POLICY VARIABLES

Recruiter Accession Objectives are the monthly objectives for male non-prior service accessions. This variable did not track the exact performance measures used, but did reflect a measure of "pressure" on the system, both long and short term. General Research Corporation provided the data.

E1 Pay is the entry level pay for new recruits. This variable was used in the analysis as a component of the ratio comparing the level of E1 Pay to the civilian minimum wage. The source of this data is the United States Army Recruiting Command (USAREC).

Production Recruiters comprise a variable that represents the number of recruiters and commanders on station each month. This variable reflects variations in the size of the recruiter force. USAREC provided this data as well.

Section IV.   NON-CONTROLLABLE ENVIRONMENTAL INFLUENCES

Youth Unemployment is estimated by the seasonally adjusted monthly unemployment rate for 16 to 19 year olds. The U.S. Department of Labor provided this data.

Civilian Minimum Wage is the monthly minimum wage as legislated by Congress, and was provided by the U.S. Department of Labor.

Navy Advertising is represented by the total monthly advertising expenditures by the U.S. Navy. The U.S. Navy confirmed the accuracy of this data.

CHAPTER 4

RESULTS

Results for the exam models and results for the accession models will be presented separately in this chapter, to parallel the model development of the two-stage process. We will begin with the results of inspecting the exam data and follow the methodological steps of Chapter 2 through to the last accession models.

Section I.   INSPECTION OF THE CATEGORY I-IIIA EXAM DATA

Seasonality And Auto-Correlation.

The univariate examination of the data structure indicated a seasonal pattern in the exam series. The exam data showed a higher than average rate of exam completions in January, and lower than average completion rates in April-May and September-October. There was also first order auto-correlation in the exam data.

Adjustment For GI Bill Termination.

A plot of the monthly exam series clearly shows a drop in the monthly rate beginning January 1977 (See Figure 4-1).   This change in the process level coincides with the termination of the GI Bill of Rights as of the end of 1976, as well as with an overall lowering of resources applied to the recruiting process. In addition to the January 1977 drop in exam level, the number of exams processed in December 1976 was extraordinarily high. It is reasonable to assume that this represented a last minute system "loading" to take advantage of the GI Bill. As such it was reasonable to treat this period as an "outlier," and to replace the number representing exams processed by the pre-1977 process mean.

We estimated the GI Bill effect by regressing exams against a 0-1 indicator variable which signaled when the GI Bill was in effect. The residuals of this regression estimate levels of exam-taking caused by factors other than the GI Bill. These residual exams were then used as the criteria in determining the immediate and delayed effects of the non-advertising variables.
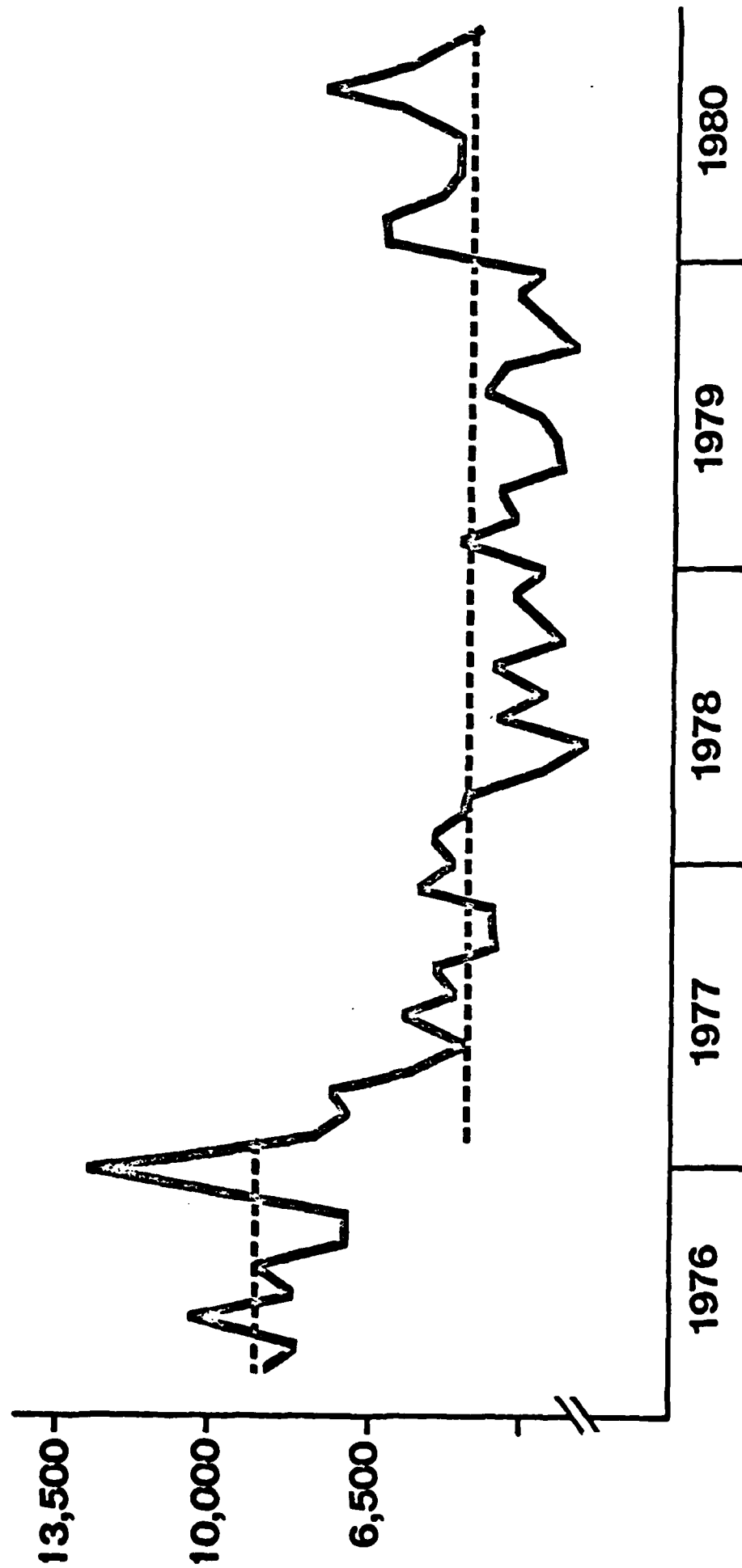
Figure 4-1. Category I-IIIA Exams

Section II.   ESTIMATION OF THE IMMEDIATE
              AND DELAYED EFFECTS OF VARIABLES
              OTHER THAN ADVERTISING ON CAT I-IIIA EXAMS

In analyzing each non-advertising variable, one at a time, we found that
no variable showed convincing evidence of long-delayed effects on exams
that could not be explained by other factors. For example, the cross-
correlation for pay indicates a positive effect on exams in the month
of the pay increase, three months later, and eight months later. Al-
though the immediate effect was not two standard deviations above the mean,
it conformed to our expectations and was accepted. The effect three months
later was not attributed to pay change: since pay increases for the military
occur every October, the three-month delayed effect would always occur in
January, a month known to be a strong exam-taking month from the seasonality
analysis. We therefore considered the three month pay effect to be spurious,
and considered the positive effect eight months later, in June, to be spuri-
ous as well.

Among the non-advertising variables, only youth unemployment was found to
have any delayed effect at all, and this effect was short-lived: it
started in the month of increased youth unemployment and lasted one addi-
tional month. This dynamic response to changing economic conditions was
considered reasonable.

The decisions we made regarding pay and unemployment are clearly judgemental,
as is usual when dealing with volatile criteria over a fairly brief time
span. The first check on these judgements was to jointly estimate the hypo-
thesized effects.

Joint estimation confirmed most of the hypothesized effects for the non-
advertising variables. Only two hypotheses failed: accounting for the drop
in exam levels in April-May by a seasonal factor and inclusion of a correc-
tion of the auto-correlation were no longer needed when all of the factors
were jointly estimated.

The model that contains only the confirmed non-advertising effects is called
the pre-advertising model and is seen in Table 4-1. Multiple regression was
used to estimate this model. The computed "t" statistics are greater than
2.0 for all variables and the computed Durbin-Watson statistic (1.9) indi-
cates no problem with auto-correction in the residuals.

Section III.   ESTIMATION OF THE CURRENT AND DELAYED
               EFFECTS OF ADVERTISING ON CAT I-IIIA EXAMS

The results of analyzing the effects of each medium, one at a time, on the
residuals of the pre-advertising model are summarized as follows:

1) TV, newspapers, and local advertising affect I-IIIA exams
    immediately (in the month of exposure or one month later).

2) All measured media generated some delayed response up to
    11 months after exposure.

Table 4-1. Mental Category I-IIIA Exam Model
            (Pre-Advertising)

VARIABLE	COEFFICIENT	"t"
Constant	-16,860	-6.6
GI Bill Indicator	2,702	8.8
Youth Unemployment	402	8.1
Objectives	.070	3.5
Relative Pay	7,535	4.3
Production Recruiters	1.79	4.8
January	1,233	4.0
September-October	-732	-3.2
Durbin Watson	1.9	
Multiple R Squared	.92	

These patterns suggested specifying advertising as two aggregate
"pressure" variables:

(1) Total Media Aggregate with long-term delay - This is a moving
     sum of all media lagged four to eleven periods. This was
     utilized because the advertising pressure affecting current
     period exam levels is the result of the spending inventory
     built up from 11 months ago through three months ago. The
     total media aggregate identified with the long delay structure
     can be viewed from two perspectives:

     - The level of exam activity in any given month is directly
       related to the level of advertising inventory, reflecting
       total advertising spending for the eight month period that
       started 11 months ago and continued until four months ago.

     - If there is an increase in advertising pressure in a speci-
       fic month, the resulting impact on processed exams will
       not be seen for three months, and then the increased
       activity will continue at the same level for another nine
       months.

(2) Immediate Response - This is the sum of current period spending
     for newspapers and local advertising, plus the most previous
     period spending for television.

Section IV.   JOINT ESTIMATION OF ADVERTISING AND
              NON-ADVERTISING EFFECTS ON EXAM-TAKING

These variable specifications were checked by estimating alternative dis-
tributed lag structures. The result of this analysis was to consider the
long-term delay to start four months after exposure and to last eight
months.

Final CAT I-IIIA Exam Model.

The final CAT I-IIIA exam model specifications include all of the key
factors identified in the pre-advertising model, as well as the two
advertising pressure variables. Multiple regression was used to estimate
the coefficients of the model. Interpretation of these coefficients and
analysis of their economic implications are discussed in detail in
Chapter 6. The coefficients and "t" statistics are presented in Table
4-2, below. Note that all of the statistics are greater than 2.0 and that
the Durbin Watson is not significant. Chapter 5 will discuss the validity
of this model in further detail.

Final CAT IIIB-IV Exam Model.

The CAT IIIB-IV exam series was analyzed in the same manner as the
I-IIIA series, with the following results:

- The same pre-advertising variable specification was identified
  (The September - October seasonal impact was only marginally
  significant, but was included to provide for consistent
  structure).

- A single advertising pressure variable was identified that
  reflected a much shorter delay structure: a moving sum of all
  media for the current period through a five-period lag.

The resulting model is presented in Table 4-3, below.

Table 4-2. Mental Category I-IIIA Exam Model

VARIABLE	COEFFICIENT	"t"
Constant	-13,841	-4.4
GI Bill Indicator	2,948	8.9
Youth Unemployment (current plus lag)	366	7.1
Objectives	0.070	3.2
Relative Pay	6,832	3.4
Production Recruiters	1.05	2.4
January	1,289	4.5
September-October	-695	-3.3
Long Term Advertising Aggregate	.10	2.2
Immediate Response Advertising Aggregate	.49	2.5
Durbin Watson	1.9	
Multiple R Squared	.93	

Table 4-3. Mental Category IIIB-IV Exam Model

VARIABLE	COEFFICIENT	"t"
Constant	-35,781	-5.6
GI Bill Indicator	5,713	7.8
Youth Unemployment (0-1)	543	4.1
Objectives	.247	5.2
Relative Pay	13,846	3.3
Production Recruiters	3.8	4.0
January	3,435	4.7
September-October	-781	-1.5
Advertising Aggregate (0-5 period lag)	.47	4.9
Durbin Watson	1.6	
Multiple R Squared	.90	

Section V. LINKING EXAMS TO ACCESSIONS

The second stage in the two-stage process is the determination of the
monthly variation in accession levels, based on the monthly variation
in exam levels. The translation of exams to accessions is developed
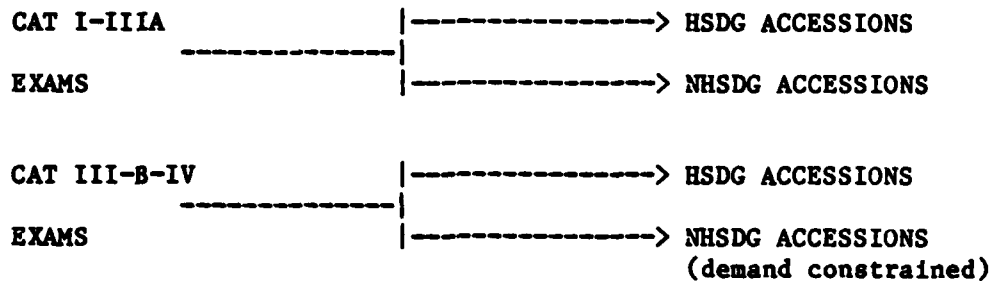by market segments, and is outlined in the following diagram.


```
CAT I-IIIA              |---------------> HSDG ACCESSIONS
              ----------|
EXAMS                   |---------------> NHSDG ACCESSIONS


CAT III-B-IV            |---------------> HSDG ACCESSIONS
              ----------|
EXAMS                   |---------------> NHSDG ACCESSIONS
                                          (demand constrained)
```

Figure 4. The Linkage Structure

Accessions and Exams.

Examination of the patterns relating monthly variations in exam levels
to monthly variation in accession levels revealed the following rela-
tionships for the market segments under consideration:

  ° HSDG/Category I-IIIA - The pattern of accession variation fol-
    lows the pattern of exam variation closely both in terms of
    long-term trends and month-to-month variation. There is very
    substantial evidence that changes in accession levels are
    closely tied to changes in exam levels.

  ° HSDG/Category IIIB-IV - The pattern of accession variation has
    the same shape as exam variation in terms of month-to-month
    variation, but there is a clear pattern of varying returns with
    respect to the long-term trend. The level of exams dropped
    sharply from the 1976 level through 1977 to a low period in
    1978, and rose through 1979 and 1980. In contrast,
    while the contract level dropped a little through the 1977
    period, it did not increase through 1979 and 1980. These
    patterns suggest that HSDG/Category IIIB-IV accessions show
    diminishing returns to increases in the level of exams.

  ° NON-HSDG/Category I-IIIA - Exam and accession variations have
    similar patterns in month-to-month variation; however, the
    general long-term patterns were not as similar.

This analysis suggested that multiplicative models allowing for diminishing returns would be appropriate in modeling the linkage between accession levels and exam levels.

Manpower Needs and Conversion Rates.

We hypothesized that variation in the level of manpower needs is a key determinant of variations in the monthly conversion rate. The recruiter objectives variable, which was the only available quantitative measure of manpower needs, was transformed to express those needs as

(1) long-term objectives - a twelve-month average of objectives, and

(2) short-term objectives - a ratio of monthly objectives to the smoothed series.

An examination of the time series plots relating conversion rates to the two objective specifications led to the following key observations:

* The conversion rate varies inversely with the level of long-term objectives for both of the High School Degree market segments.

* The conversion rate varies directly (but weakly) with the level of short-term objectives for both of the High School Degree market segments.

* The conversion rate varies independently of the level of both the long- and short-term objectives for the Non Degree/Category I-IIIA market segment.

It was clear from these observations that "pressure" on the recruiting system had differing impacts on the number of prospects brought into the process through the examination stage, and on the number of those prospects who eventually enlist in the Army.

Impact of the Other System Variables on the Level of Exams.

It was important to investigate the possiblity that variation in one or more of the other key system variables would impact the mix of people who came in to take exams, with respect to their propensity to eventually enlist.

This was tested by specifying a multiplicative model relating accession variation to exam levels and to all of the policy and environmental variables already identified as key to describing variations in the recruiting process.

Because of the complexity of the exam model specification, the hypothesis that a variable had an effect on accessions beyond its effect on exams was rejected, unless there was strong evidence to the contrary (t-statistics well over 2.0). We found that the termination of the GI Bill had a negative impact on the conversion of accessions to exams for the HSDG/CAT I-IIIA market segment, but that no other variables affected accessions more than they affected exams for any of the market segments.

Final Linkage Models.

The key observations regarding the linkage between exam levels and
accession levels (diminishing returns of accessions to exams, the
importance of objectives, and adjustment for the GI Bill) led to the
following linkage model specifications for each of the market segments
(Tables 4-4, 4-5 and 4-6). The estimated models were linear in the
logarithms of the dependent variable (accessions) and the independent
variables, in order to specify the multiplicative models required. The
estimated coefficients are the elasticities. There was strong indication
of auto-correlation in the residual series when ordinary least squares
were used. Therefore, the Cochrane-Orcutt algorithm, which adjusts the
estimates based on the assumption of a first-order auto-correlation in the
residuals, was used to estimate the equations.

TABLE 4-4. HSDG/Category I-IIIA Accessions (in Logarithms) Model

VARIABLE	COEFFICIENT	"t" STATISTIC
Constant	6.97	3.4
Log (CAT I-IIIA Exams)	.86	8.7
Log (Long-Term Objectives)	-.71	-2.9
Log (Short-Term Objectives)	.078	2.0
GI Bill Indicator	.27	3.5
Auto-Correlation Coefficient	.35	2.6
R^2	.88	

TABLE 4-5. HSDG/Category IIIB-IV Accessions (in Logarithms) Model

VARIABLE	COEFFICIENT	"t" STATISTIC
Constant	11.4	4.8
Log (Cat IIIB-IV Exams)	.61	4.7
Log (Long-Term Objectives)	-.97	2.9
Log (Short-Term Objectives)	.17	3.3
Auto-Correlation Coefficient	.47	3.7
R^2	.62	

TABLE 4-6. NHSDG/Category I-IIIA Accessions (in Logarithms) Model

VARIABLE	COEFFICIENT	"t" STATISTIC
Constant	1.9	1.1
Log (Cat I-IIIA Exams)	.61	3.2
Auto-Correlation Coefficient	.81	9.5
R^2	.77	

The validity check consisted of the following procedures:

- Review of the goodness of fit of the models.

- Review of the structural sensitivity of the fitted exam models
  to excluded variables and to re-estimated the model structure
  over a split-half time frame.

As outlined below, the results of executing these steps show that the
developed models track the actual accession data well, and were robust
with respect to the tests used.

Section I. GOODNESS OF FIT

Fitting Procedure.

The fitted accessions from the two-stage model for each target group
were calculated in two steps. First, exam levels were calculated using
advertising, other controllable variables, and non-controllable environ-
mental factors. Then accessions for each segment were determined using
the calculated exams (for the appropriate mental category) in the appro-
priate linkage models.

Evaluation of Fit.

The goodness of fit evaluated how well the model structure tracked the
monthly recruiting performance data over the time frame used to esti-
mate the models. The fit was examined for each of the two exam models,
for the accession models of each of the three key market segments
(based on the two-stage procedure), and for aggregates of the accession
market segments.

The squared correlation between the actual and fitted exam and accession
series indicates good fits. For the aggregate accession series, the
components were added for the actual and fitted series, and the corre-
lation between the fitted and actual aggregates was computed. The
squared correlations range between 64% and 93%, which indicates a high
degree of accuracy in explaining the series variations.

The Fits are presented in Table 5-1, below.

Table 5-1. Goodness of Fit

EXAM MODELS	R^2
I-IIIA EXAM	.93
IIIB-IV EXAM	.90

2-STAGE ACCESSION MODELS	
High School Degree/Category I-IIIA	.88
High School Degree/Category IIIB-IV	.64
Non-Degree/Category I-IIIA	.72
All Market Segments Combined	.86
Total High School Degree	.86

Section II. STRUCTURAL SENSITIVITY OF FITTED EXAM MODELS

Variable Exclusion.

In evaluating the robustness of the multivariate structure specified in the exam models, it was important to determine whether the structural implications of each of the independent variables (coefficient sign and order of magnitude of coefficient size) had been strongly biased by the inclusion of one of the other variables in the model specification.

Dropping each of the variables from the model specification individually, and re-estimating the coefficients of the remaining variables provides a test of this structural sensitivity. In executing this procedure, particular attention was paid to the impact on the advertising variables.

This procedure was carried out for both of the exam models with the following results:

* The advertising variables in both of the exam model specifications maintain consistent signs and sizes when each of the other variables is removed.

* The other variables all maintain consistency with respect to sign when other variables are removed, although the size of the coefficients is less stable for some of the variables.

* The overall system structure is highly stable for both models.

Split-Half Analysis.

The time frame examined was split into two parts, and the coefficients
in each of the specified exam model structures were re-estimated. The
purpose of this exercise was to verify that the basic model structure
provides an appropriate description of the process that is consistent
across different time spans.

Each of the resulting split time frames had 27 observations. These
samples were clearly too small to attach any degree of statistical
significance to the results; however, in a directional sense, the
results provided clear evidence of the stability in the model structure.

The resulting analysis showed a high degree of structural robustness.
With the exception of the production recruiter variable, each of the
estimated variable coefficients kept the same sign in both samples.
There was variation in the magnitude of the coefficients, most notably
in the relative pay variable, but this would be expected given the
small sample sizes.

Overall, the basic structure of the estimated system showed little sen-
sitivity to the change in time frame.

CHAPTER 6
ECONOMIC IMPLICATIONS

The purpose of this chapter is to investigate the economic implications of the model results that were described in Chapter 4 and validated in Chapter 5.

Section I. PROCEDURES

All of the economic implications described in this chapter are based on a simple procedure: we tested what would have happened to recruiting in Fiscal Year 1980 if we had increased any of the key factors in the model by 10% over the FY80 level, while not altering any other factors. Key factors that were tested one by one in this manner include youth unemployment, civilian minimum wage, starting pay, the number of recruiters, total accession objectives, and media expenditures in FY80 dollars.

Testing the impact of a 10% increase in a factor required two steps. First, we calculated the increase in FY80 exams resulting from a 10% increase for any given factor. Since the two exam models are linear, we computed the increase in exams by multiplying the factor's coefficient in each exam model by 10% of the factor's FY80 level.

We then computed the eventual change in accessions by using the linkage models. In testing most of the variables, the impact of a 10% change on accessions is accomplished by first adding the incremental exams calculated in Step 1 to the FY80 exam levels, and then running the linkage models to predict the impact on accessions in FY80.

Section II. RESULTS

The results of testing a 10% increase in each of the key factors one by one is shown in Table 6-1. The first column of numbers indicates the magnitude of a 10% change in each key factor. For example, youth unemployment was 17% in 1980. The second column indicates any incremental cost to the Army (The incremental cost of a 10% increase in pay is set at $72MM. This figure assumes that only new accessions receive the increase in pay. The incremental cost of a recruiter is assumed to be $30,000. Media expenditures during FY80 were $27MM in dollars deflated to December 1978 levels. These expenditures in 1980 dollars would equal about $31MM. We then adjusted this figure down to $30MM to reflect the fact that FY80 recruiting was impacted by the delayed effect of advertising in FY79, a year in which inflation-adjusted media expenditures were less than they were in FY80).

The third and fourth columns represent incremental accessions on prime and HSDG accessions respectively. For example, if FY80 youth unemployment had been 1.7% higher, the models detailed in Chapter 4 predict that the Army would have gained approximately 2,400 more prime accessions.

Table 6-1. Incremental Accessions Due To Increasing
            Key Factors 10% Beyond Their 1980 Levels

Incremental Accessions

| | Amount of Change | | CAT I-IIIA | any | CAT I-IIIA NHSDG or any |
	change	cost ($MM)	HSDG	HSDG	HSDG
Unemployment	1.7 points	—	2,400	4,200	5,200
Minimum Wage	+31¢/hr.	—	-2,300	-4,400	-5,400
Starting Pay	$44/mo.	$72*	2,300	4,400	5,400
Recruiter Force	533 bodies	$16**	2,200	5,800	6,700
Total Objectives	1,100/mo.	—	-1,800	-5,200	-5,000
Advertising (in 1980 dollars)	—	$ 3	900	2,000	2,400

* A budget increase of $72MM is required to give new accessions a 10%
    increase in real starting pay. The cost of increasing pay through-
    out the Army is not included.

** The incremental cost of a recruiter is assumed to be $30,000.

The effect on total high school accessions (Column four), was computed by combining the effects on CAT I-IIIA and CAT IIIB-IV HSDG accessions. The last column indicates the full incremental effect on all accessions by adding the effect on CAT I-IIIA HSDG accessions to the incremental HSDG accessions.

The effects of these changes upon CAT IIIB-IV NHSDG accessions were not considered, since this group is primarily a filler group. For example, while more IIIB-IV prospects would want to enlist if youth unemployment increased, more would not necessarily have been accessed. As discussed in Chapter 4, the conversion of NHSDG/IIIB-IV exams is not determined by the supply of NHSDG/IIIB-IV exams but by the Army's total accession objectives and success in converting better qualified prospects.

Implications of a 10% Increase in Advertising.

A $3MM increase in media expenditures would have gained the Army approximately 900 incremental prime accessions, 2,000 incremental HSDG accessions, or 2,400 incremental accessions in full.

Implications of Increasing Advertising Expenditures by $1,000,000.

Figure 6-1 presents a graphic representation of a $1.0MM increase in the advertising budget. One million dollars attracts approximately 300 prime recruits, 370 other HSDG recruits and 130 smarter than average males without a high school degree, adding up to 800 incremental accessions.
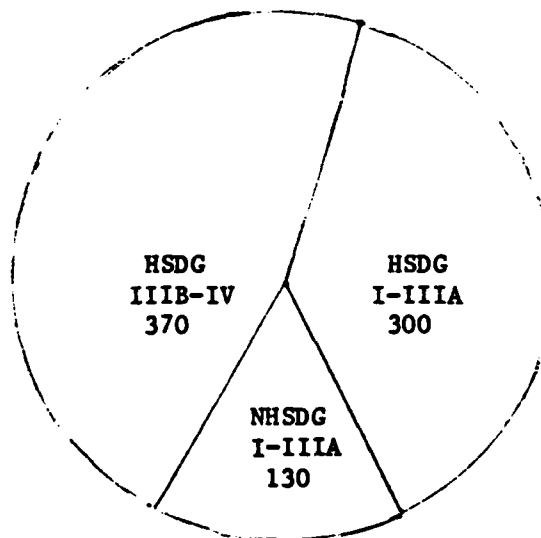

Figure 6-1. Effects Of An Additional $1.0MM In Advertising

These figures were calculated by simply dividing the effects of a $3MM increase by three. While simple division ignores the issue of diminishing returns to advertising implied by the multiplicative linkage model, we felt comfortable in simplfying the analysis, since the number of additional accessions we would have added to the pie chart in Figure 6.1 is so small that we cannot reliably report such differences.

Advertising Costs Per Recruit.

The advertising costs per recruit of adding $1.0MM to the advertising budget are presented in Table 6-2. A prime incremental accession costs $3,300 while an incremental accession in general has an average cost of $1,250.

A cost of $3,300 per prime recruit may sound high, but one must remember that we are not discussing the advertising costs of attracting a trial user of toothpaste: this is the incremental advertising cost to attract a smarter than average young man with a high school degree who will commit three years of his life, or perhaps his entire life, to his country.

Table 6-2. Advertising Costs Per Recruit*

	Best Estimate	67% Confidence Range
CAT I-IIIA, HSDG	$3,300	$2,500-$6,200
Any HSDG	$1,500	$1,200-$2,200
Any HSDG or I-IIIA, NHSDG	$1,250	$ 900-$1,900

* Assuming 1980 media mix, 1980 dollars

Relative Cost-Efficiency Of Advertising.

Increasing advertising is a more cost-effective way of increasing enlistments than increasing either recruiters or starting pay. The relative costs per recruit are seen in Table 6-3. Increasing advertising is approximately ten times more cost-effective than increasing starting pay, and is approximately twice as cost-effective as a comparable increase in the recruiter force.

Table 6-3. Relative Cost Efficiencies

	Incremental Cost Per Recruit*		
	CAT I-IIIA HSDG	any HSDG	CAT I-IIIA NHSDG or any HSDG
Relative Pay (Starting Pay/Min. Wage)	$31,000	$16,000	$13,000
Recruiter Force	7,200	2,800	2,900
Advertising	3,300	1,500	1,250

*Based on increasing each variable by 10%.

Increased Objectives.

Increasing pressure on the recruiting system has historically been counter-productive, as Table 6.4 below shows. A 10% increase in total objectives has a negative overall effect on all accessions (except for the CAT IIIB-IV/NHSDG market segment: if the increased quantity objectives are met, but they result in a decrease in the accession of the recruits from the three quality groups, then the accession of CAT IIIB-IV/NHSDG recruits must increase). The models show that pressure increases the number of exam-takers, but depresses conversion rates enough to make the overall result negative.

Table 6-4. Effect of Increasing Total Objectives By 10%

Market Segment	Effect on Accessions
CAT I-IIIA/HSDG	- 5%
Any HSDG	-10%
Any HSDG or CAT I-IIIA	- 5%

Effect of GI Bill Termination.

The termination of the GI Bill had a major impact on recruiting, as seen in Table 6-5 below. Nevertheless, we wish to emphasize that we do not believe that restoration of the GI Bill will result in recouping these recruits in the short run, since its termination coincided with major policy changes and budget cuts. In addition, the program's 30-year history contributed to its universal awareness, and government loans and grants to educational assistance have tripled since the bill's termination, further complicating attempts at projecting restoration effects.

Table 6-5. Effect of Terminating the GI Bill

Market Segments	Effect on Accessions
CAT I-IIIA/HSDG	down 11,000/year
Any HSDG	down 22,000/year
Any HSDG or CAT I-IIIA	down 27,000/year

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